THE WEATHER AND CIRCULATION OF AUGUST 1956[1]

A Marked Reversal in Hurricane Activity from August 1955

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1. MID-SUMMER PERSISTENCE FOLLOWING AN EARLY-SUMMER REVERSAL

In June 1956 [1] the large-scale circulation features controlling the weather in the United States were two troughs, one near either coast of North America, separated by a stronger than normal ridge lying north-south over mid-continent. During July [2] a blocking surge, which had been centered over northern Canada in June, extended westward to Alaska and eastward to Greenland. This was accompanied by retrogression of the major troughs and ridges and a southward shift of the westerly wind belt in eastern North America and the Atlantic.

Comparison of the mean 700-mb. circulation patterns for July (see fig. 2 of [2]) and August (fig. 1) shows them to be highly intercorrelated. The magnitude of this persistence in circulation is expressed statistically in table 1, which shows that the correlation coefficient between the 700-mb. height anomaly patterns of July and August 1956, in the area from 30° N. to 50° N., and 70° W. to 130° W., was +.76. The area was restricted in order that the results might be comparable with those found by Namias in a previous study for the period from 1942–50 [3]. This unusually high correlation is even more interesting in view of the pronounced reversal in pattern which occurred from June to July, as shown in the first column of table 1.

The weather in the United States, closely related as it is to the mid-tropospheric circulation, similarly exhibited very little change from July to August 1956. Perhaps this is best seen by comparing figures 2 and 3, which show the observed temperature and precipitation anomaly classes for these two months. Statistical measures of this persistence are given in table 1. Of 100 stations evenly distributed around the country, 85 did not change by more than one class in temperature, while 43 remained in the same precipitation class. These figures represent considerably greater persistence than would be expected either by chance or from the 1942–50 average [3]. From June to July, by contrast, the reversal in temperature was striking. Precipitation however, displayed even greater persistence than is normally found between June and July (table 1). This is a bit unusual, in view of the reversal in circulation, and may reflect the discontinuous nature and randomness of precipitation patterns in the summer months, as well as the complexity of their relationship to mean summer circulation states.

[1] See Charts I–XVII following p. 328 for analyzed climatological data for the month.

2. WEATHER AND CIRCULATION IN THE UNITED STATES

TEMPERATURE

Temperatures in the United States during August averaged generally below normal in the northeastern quarter and western third of the country (fig. 2B and Chart I). In the Northeast the greatest departures observed were from 1° to 3° F. These are somewhat less than the 3° to 5° F. departures observed in the same region in July [2]. Northern Maine was the coolest area, with Caribou reporting its second coldest August of record, while daily minimum temperature records were established at Buffalo, N. Y., (Aug. 3), and Scranton, Pa. (Aug. 4).

The cool weather in the Northeast may be related to the monthly circulation pattern in several ways. Figure 1 shows that stronger than normal northwesterly flow prevailed at the 700-mb. level from the strong ridge over western Canada to the deep trough along eastern North America. Wind speeds in this area, where the jet stream was well defined at 700 mb., were above the normal, with greatest departures over the Lakes region (fig. 4).

The prevailing northwesterly flow was instrumental in steering the polar anticyclones that were associated with frequent outbreaks of cool Canadian air masses (Chart IX). The source region for much of this cool air, northwestern Canada and the Arctic region, was colder than the August normal, as can be seen in figure 5, which shows the mean thickness departures from normal for the layer 700 mb. to 1000 mb. Greatest mean virtual temperature

TABLE 1.—*Persistence measures of monthly mean anomalies in the United States during summer 1956*

	June-July		Chance	July-August	
	1956	(1942–50)		1956	(1942–50)
700-mb. height (lag correlation)	−0.61	0.33	0	0.76	0.33
Temperature (0 or 1 class change, percent)	43	72	59	85	82
Precipitation (0 class change, percent)	45	35	33	43	34

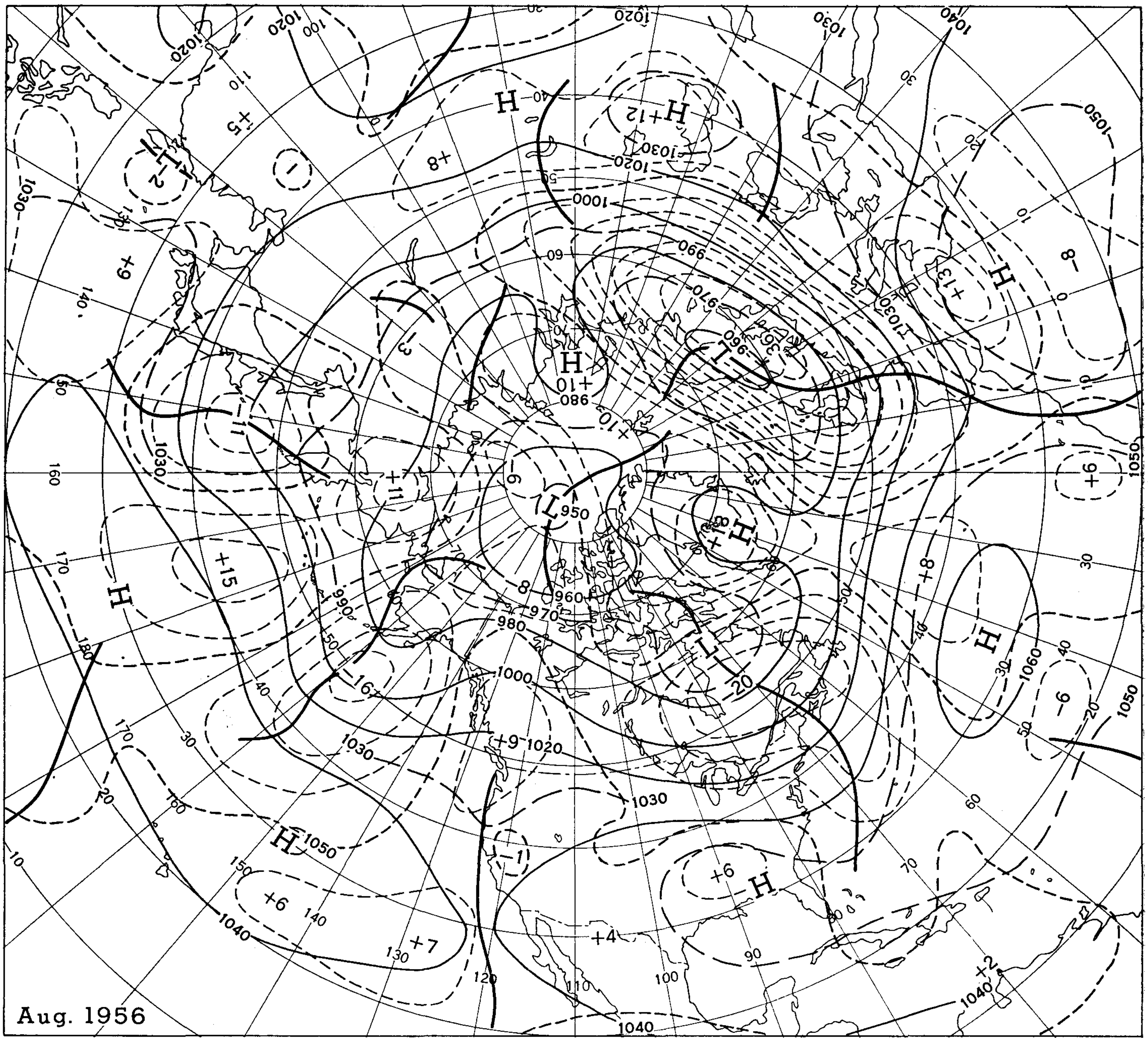

FIGURE 1.—Mean 700-mb. height contours and departure from normal (both in tens of feet) for August 1956. Deeper than normal troughs over eastern North America and western Europe were important features of the circulation.

departures (−8° F.) were found over southeastern Canada, another source region for much of the cool weather in the northeastern United States.

Temperatures also were below normal over most of the area from the Northern Plains to California (fig. 2B and Chart I), with maximum departures of 4° F. in central California. A few of the cities establishing daily minimum temperature records were: Helena, Mont.; Roseburg, Oreg.; Ely, Nev.; and Salt Lake City, Utah. The unseasonable coolness in the West was associated with below normal thickness values in the layer from 700 mb. to 1000 mb. (fig. 5) and was related to the prevalence of stronger than normal northerly flow at sea level (Chart XI). The greatest daily temperature departures in the Far West occurred early in the month when the mean trough along the Pacific coast was inland. For the five days ending August 5, temperatures in that area averaged as much as 15° F. below normal. For a detailed study of this cold period, the reader is referred to the article by McQueen and Thiel elsewhere in this issue [4].

The remainder of the nation, from the Central and Southern Plains through the South Atlantic States, was unseasonably warm, with maximum temperature departures of 4° F. in parts of Kansas and Oklahoma (fig. 2B

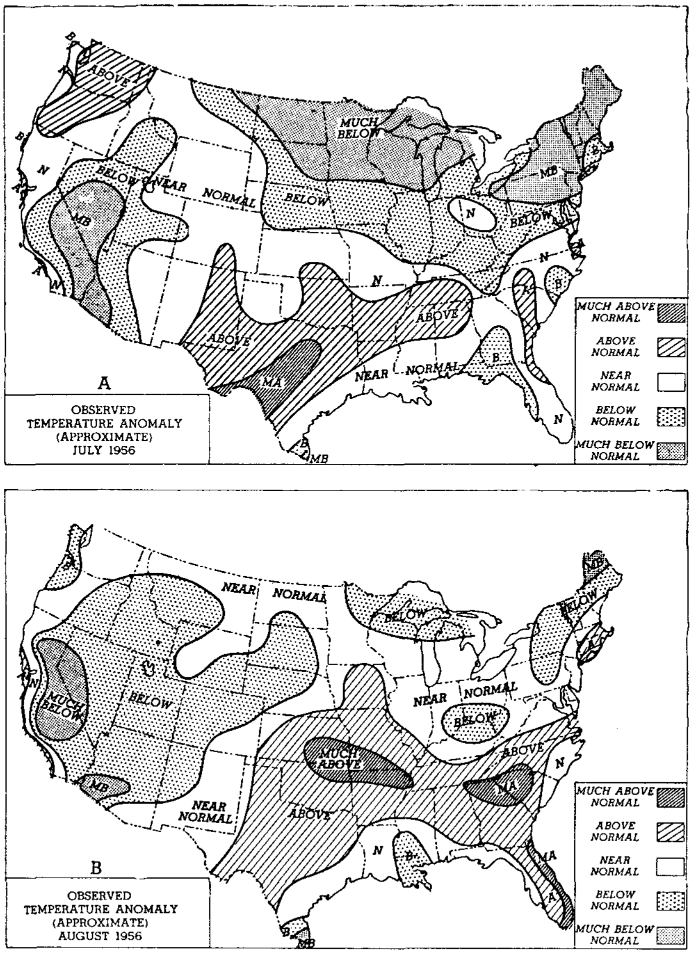

FIGURE 2.—Monthly mean surface temperature anomalies for (A) July 1956 and (B) August 1956. The classes above, below, and near normal occur on the average one-fourth of the time; much below and much above each normally occur one-eighth of the time.

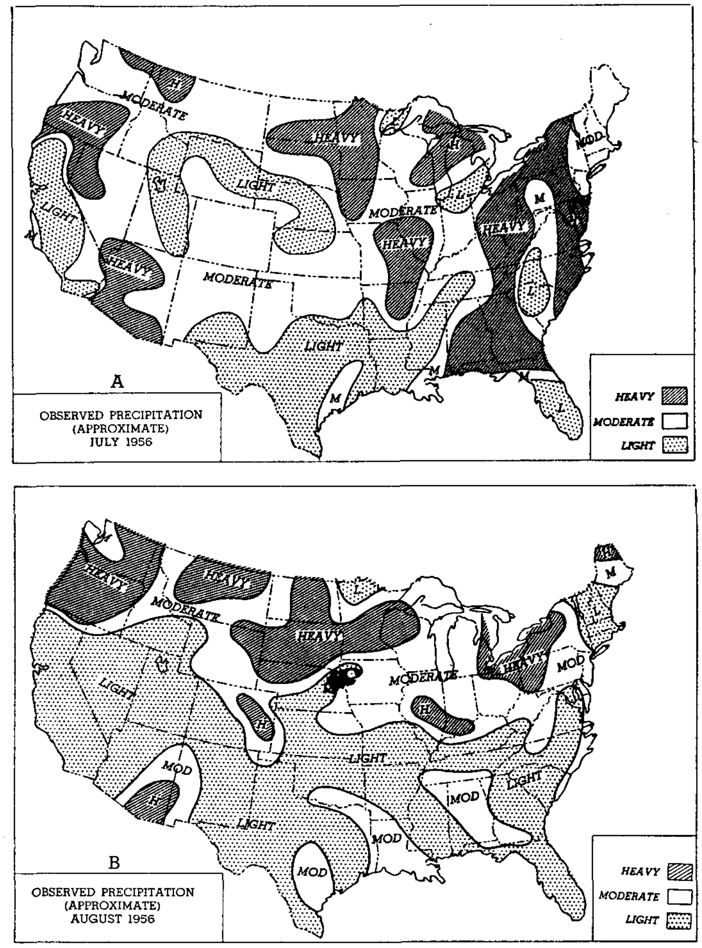

FIGURE 3.—Monthly precipitation anomalies for (A) July 1956 and (B) August 1956. The classes light, moderate, and heavy each normally occur one-third of the time.

and Chart I). Some of the daily maximum temperature records established were (in ° F.): Tulsa, Okla., 109 (5th and 6th); Dallas, Tex., 109 (5th); Concordia, Kans., 108 (16th); and Augusta, Ga., 104 (6th). Above normal temperatures in this area were related directly to the warm dynamic upper-level anticyclone centered over the Gulf States (fig. 1 and Charts XIII–XVI). Note that the area of abnormal surface warmth corresponds quite well to the area of above normal 700-mb. heights and to the region of positive thickness departures in the layer from 700 mb. to 1000 mb. (fig. 5). In addition, the belt of confluence, with stronger than normal wind speeds (fig. 4B), stretching from the Dakotas to the Middle Atlantic Coast (fig. 1), served to contain the cold air to the north and warm air to its south (fig. 2B and Chart I).

Shortly after mid-month, when the western Canadian ridge reached its greatest strength, a strong Polar anticyclone brought the coolest weather of the month to a wide area from the northern Plains to the Gulf and South Atlantic Coasts (see anticyclone track, Chart IX). In portions of the Central Plains and middle Mississippi Valley daily maximum temperatures fell into the 60's and 70's, where they previously had been reaching 100° F. Numerous daily minimum temperature records were established from the 19th to 23d, while some areas near the Gulf Coast experienced their lowest temperature ever recorded in August. Among the latter were Jackson, Miss., 54° F. (23d), and Baton Rouge, La., 60° F. (23d); while the 59° F. at Mobile, Ala. on the 22d was the lowest temperature ever observed there so early in the pre-fall season. Before arrival of the cooler air at Shreveport, La., temperatures had reached 100° F. or more on 15 consecutive days, an all-time record.

PRECIPITATION

Above normal amounts of precipitation were observed quite generally in the northern half of the United States, with portions of the Far Northwest, the Upper Mississippi Valley, and the eastern Great Lakes region receiving twice their normal amount (fig. 3B and Chart III). For some areas from the Dakotas to New York this was the wettest August in 16 years; while at Syracuse, N. Y., a fall of 8.41 inches was the greatest for any August.

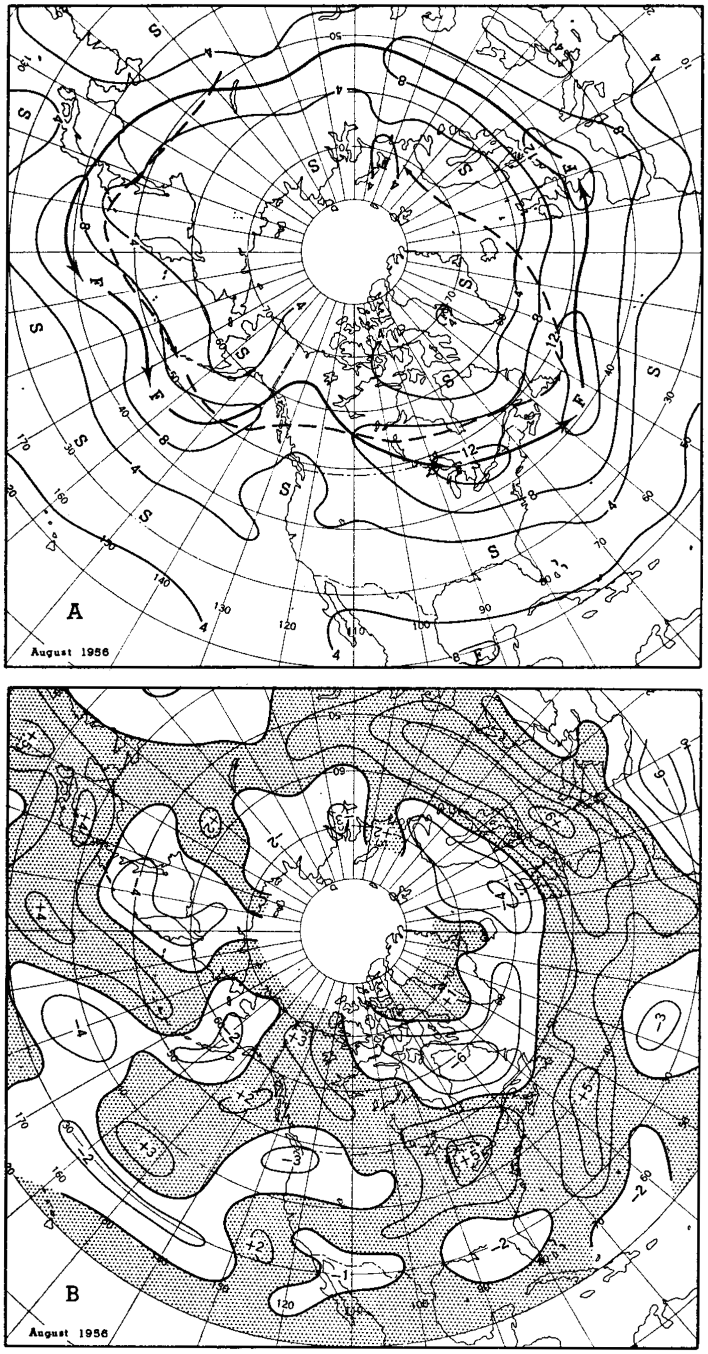

FIGURE 4.—(A) Mean 700-mb. isotachs and (B) departure from normal wind speed (both in meters per second) for August 1956. Solid arrows in (A) indicate major axis of westerly jet, while dashed arrows show mean position of corresponding jet during August 1955. Positive wind speed anomalies in (B) are shaded. Fast westerly flow, south of normal, prevailed from the Great Lakes across the Atlantic through Europe and Central Asia.

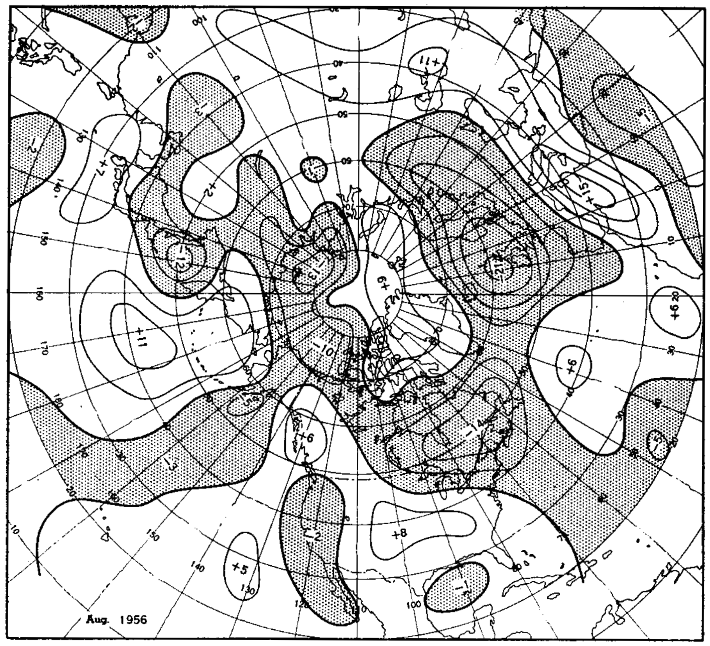

FIGURE 5.—Departure from normal of mean thickness (tens of feet) for the layer 700–1000 mb. for August 1956, with subnormal values shaded. Cold pool of air centered in southeastern Canada was associated with unseasonably cool weather in the northeastern United States. Note also the extreme cold over Great Britain and most of Europe.

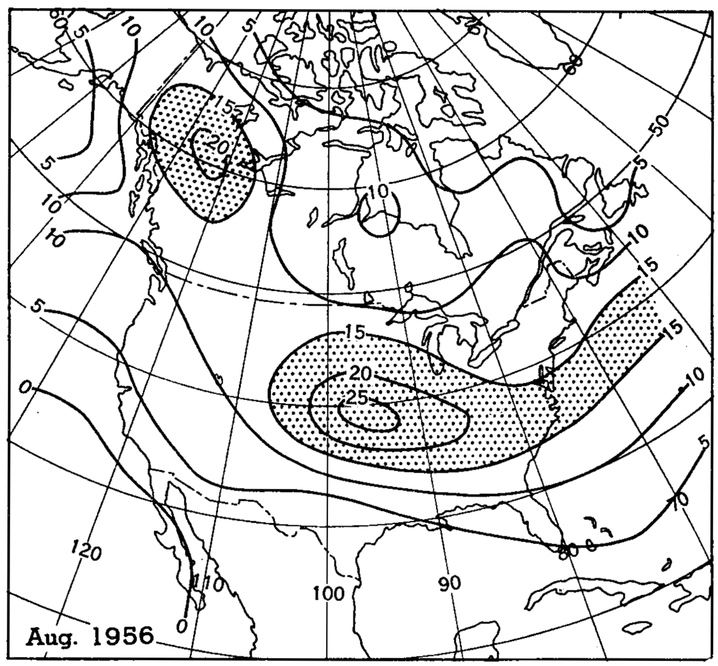

FIGURE 6.—Number of days in August 1956 with surface fronts of any type (within squares with sides of approximately 500 miles). Frontal positions taken from *Daily Weather Map*, 1:30 p. m. EST. Cool, showery weather prevailed quite generally north of the belt of maximum frontal frequency.

This broad belt of precipitation may be related directly to the 700-mb. circulation pattern (fig. 1). Principal contributing factors were confluence and strong cyclonic curvature to the rear of the mean trough over eastern North America. At sea level, the daily cyclones associated with much of this precipitation followed a path from the Northern Plains through the Great Lakes, thence northeastward (Chart X). Most of this precipitation was in the form of showers and thundershowers and fell to the north of the zone of highest daily frontal frequency (fig. 6). In Kansas and Missouri sea level fronts were present as much as 80 percent of the time, and sea level pressures averaged 3 mb. below normal for the month (Chart XI, inset). Rainfall in the Northwest can be attributed largely to two upper-level cyclones, one at the beginning of the month [4], the other during the last week. These occurred as the west coast trough built northward into the westerlies in response to temporary fluctuations of the long-wave pattern over the Pacific.

Most of the southern half of the country received considerably less than the normal amount of precipitation expected during August (fig. 3B and Charts II, III). The area around Columbus, Ga, suffered its driest August since 1882, while the year just ended at Prescott, Ariz., was the driest of any similar calendar period since 1876–77. Lack of moisture was the principal weather feature during the month in parts of the Central and Southern Plains States, where drought conditions had become quite serious at month's end. This pattern of hot dry weather continued the trend of recent years.

These widespread dry conditions were associated with the extensive upper level anticyclone (fig. 1 and Charts XIII to XVI). At the 700-mb. level heights were predominantly above normal, the largest anomaly being over northern Mississippi. Anticyclonic curvature and wind shear were responsible for large-scale subsidence, and, combined with a weaker than normal import of Gulf moisture in lower levels (Chart XI, inset), can be related to the precipitation deficiency.

3. HURRICANE BETSY AND THE LARGE-SCALE CIRCULATION

One tropical storm developed in the southern portion of the North Atlantic during the month and subsequently reached full hurricane intensity. The relation of this storm, named Betsy, to the large-scale circulation pattern is rather straightforward. This is because the circulation in the area and period affected by the storm was representative of the flow pattern existing during the entire month. This was to be expected because the life history of hurricane Betsy occurred during the middle of the month, a time when the flow pattern is most likely to approximate the monthly mean circulation.

The path followed by Betsy is shown in figure 7, superimposed upon the monthly mean 700-mb. contours (same as fig. 1). First spotted August 9, about 900 miles east of the Leeward Islands, Betsy whirled rapidly west-northwestward in the sub-tropical easterlies. The storm passed directly over Puerto Rico, where much damage was done and several lives were lost. (See Weather Notes, p. 311 of this issue.) Skirting the Bahamas, the hurricane, with winds up to 120 m. p. h., posed an immediate threat to the coastal United States. However, as Betsy escaped from the easterly wind belt it decelerated and began a turn toward the north, thus missing the coast but bringing moderate to heavy rains to southeastern coastal areas. After recurvature, the hurricane moved parallel to the coastline and then was swept rapidly eastward as it

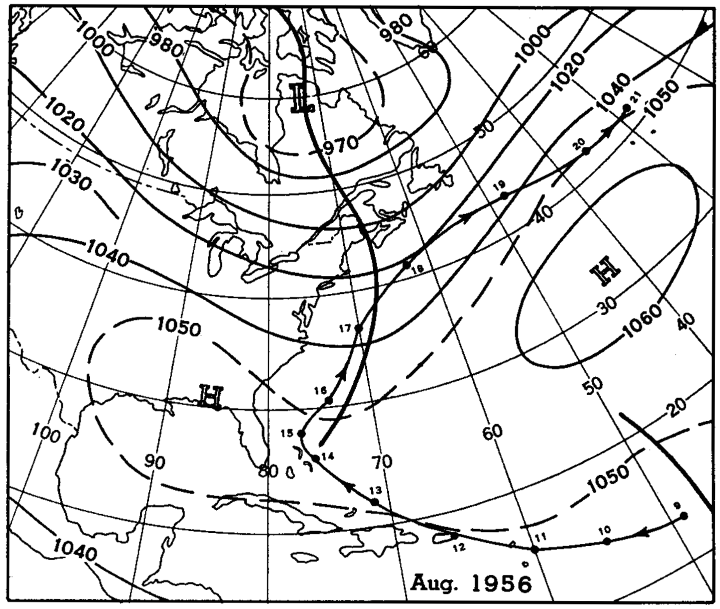

FIGURE 7.—Track of hurricane Betsy, August 9–21, 1956, superimposed on monthly mean 700-mb. contours (same as in fig. 1). Positions given are for 0730 EST. Steering of Betsy by the mean circulation is well indicated.

approached the area of strongest west winds (fig. 4), dissipating in mid-Atlantic on the 21st. In sparing the Atlantic Coast a devastating blow, Betsy did not follow in the path of some of her more famous sisters of recent years.

4. CIRCULATION OF AUGUST 1955 AND AUGUST 1956 AS RELATED TO HURRICANE ACTIVITY

During August 1955 [5] hurricanes Connie and Diane, with their flood-producing rains, inflicted much damage upon the northeastern United States. In view of the lack of hurricane activity in this area during August 1956, it was deemed of interest to compare differences in the large-scale planetary circulation patterns for the two months, August 1955 and August 1956. This comparison is, perhaps, best seen in figure 8, which shows the 700-mb. height differences between the two months. There are two very striking features: (1) the widespread and large positive height changes in Polar regions, associated in part with blocking, and (2) the extensive belt of height falls at middle latitudes encircling nearly the entire Northern Hemisphere.

These changes in 700-mb. height were associated with a southward displacement of the hemispheric zonal wind systems from August 1955 to August 1956. That these displacements were quite significant can be seen from figures 4A and 9, where these wind systems are compared. The maximum westerly wind belt (or jet) was displaced equatorward from August 1955 to August 1956 over nearly the whole Northern Hemisphere, with greatest displacement over eastern North America, the Atlantic, and Europe.

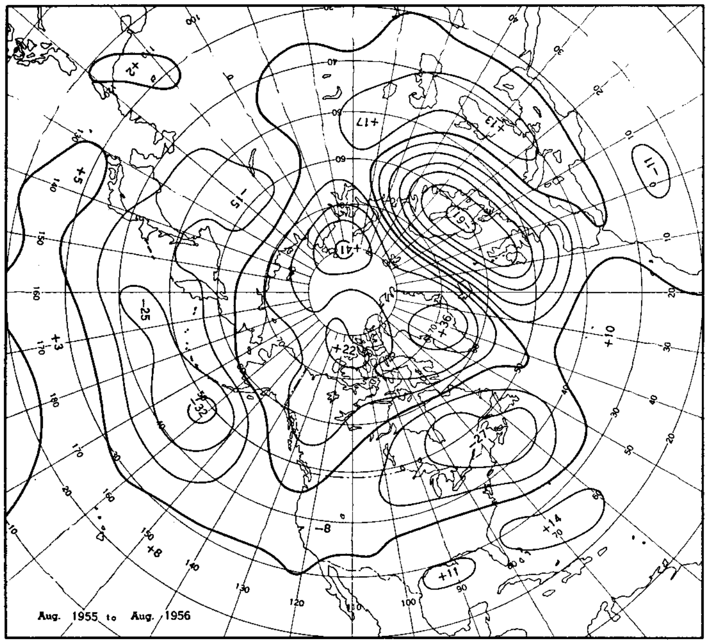

FIGURE 8.—Mean 700-mb. height change (in tens of feet) from August 1955 to August 1956. Areas of large change were associated with marked reversal of the planetary circulation.

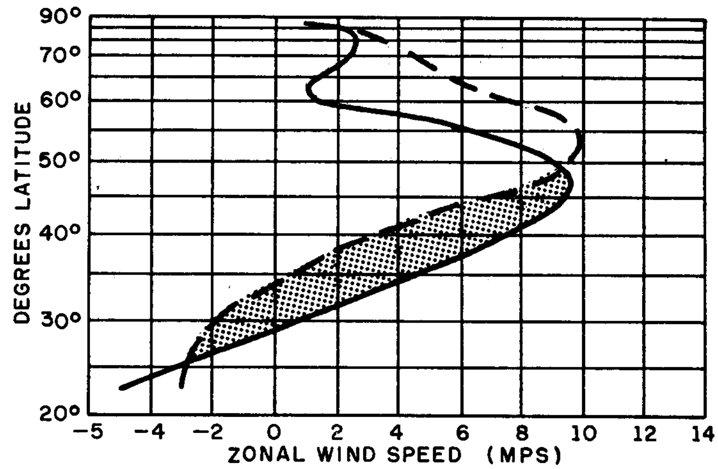

FIGURE 9.—Mean 700-mb. zonal wind speed profiles in the Western Hemisphere for August 1956 (solid line) and August 1955 (dashed line). Note the southward displacement and increase in speed (shaded area) of the hemispheric zonal wind systems from August 1955 to August 1956.

In a recent unpublished study, Ballenzweig [6] has shown that there is a strong tendency for tropical cyclone activity to be at a maximum during years when the mean westerly jet at the 700-mb. level (averaged between 100° and 50° W. long.) is displaced north of normal, and at a minimum when this jet is displaced to the south. The evidence thus far during the early part of the 1956 hurricane season supports this relationship very strongly. Only one tropical storm was observed during August 1956, when the westerlies were south of their normal position, while four tropical cyclones (three full hurricanes) developed in August 1955, when the westerlies were displaced north of normal (fig. 9) [5].

The poleward shift of the westerlies and the axis of the subtropical High over eastern North America in midsummer 1955 [5, 7] was related directly to the more northward paths taken by hurricanes Connie and Diane before full recurvature. At the same time the weather in the northeastern United States in summer 1955 was abnormally warm with record-breaking rains. These conditions were in decided contrast to the cool, relatively dry regime which prevailed this August (section 2).

An even more pronounced change in circulation occurred over Europe and the eastern Atlantic, where heights at 700 mb. fell sharply, as much as 610 ft., over Scandinavia (fig. 8). This was accompanied by a decided reversal in the circulation pattern, from anticyclonic to cyclonic. At the same time the primary westerly jet axis was displaced southward some 20° of latitude (fig. 4A).

It has been theorized [5] that the strength and northeastward protrusion of the Azores anticyclone is related to the frequency of occurrence of Cape Verde type storms. If this be true, then the circulation pattern of August 1956 was such as to suppress the genesis of such storms. In this connection the height rises near the Azores (fig. 8) may be indicative of filling of the mean trough which may have spawned hurricane Connie in August 1955.

Thus, it would appear that during August 1956 the large-scale planetary flow pattern was not as favorable for the formation and development of hurricanes as it was during August of 1955. Moreover, the southward displacement of the westerly wind belt in eastern North America greatly diminished the chance of any of these storms striking the north Atlantic Coast.

5. WEATHER AND CIRCULATION FEATURES ELSEWHERE IN THE NORTHERN HEMISPHERE

During August 1956 blocking tended to persist in higher latitudes around a large portion of the Northern Hemisphere, although it was somewhat weaker than in July [1]. At the same time the Polar Low was very weak, in sharp contrast to the intense vortex present in July. The principal block was centered over Greenland, where 700-mb. heights were 180 ft. above normal (fig. 1) and sea level pressures as much as 7 mb. above normal (Chart XI, inset). This block effected a displacement of the westerlies south of normal and similarly affected the associated storm track over the eastern Atlantic and Europe.

By far the largest height anomaly was the −360-ft. center (over Scandinavia) associated with the deep trough over western Europe (fig. 1). This anomaly was one of the most extreme negative centers ever to occur during a summer month in the Atlantic or European areas since 1933. It has been exceeded only by the −380-ft. anomaly in the Atlantic in June 1947, and the −370-ft. center over Greenland in July 1955. This abnormally deep center, along with the belt of positive anomaly over North Africa, combined to produce very fast westerlies with a well-defined jet from the eastern Atlantic to central Asia. Wind speeds were as much as 9 m. p. s. above normal over central Europe (fig. 4B.)

The weather associated with the deep trough and negative anomaly center was unseasonably cool and rainy with much storminess. Cyclonic activity entering Europe from the Atlantic was unusually intense for summer, with sea level pressures averaging from 7 mb. below the August normal in Great Britain to 11 mb. below normal in northwestern Russia. Throughout most of the British Isles there was a considerable deficiency of sunshine, and thunderstorms were unusually frequent. New August precipitation records were established in some districts. Persistent northeasterly flow at sea level swept cool Arctic air masses into Europe, where, in the layer from 700 mb. to 1000 mb., mean virtual temperatures averaged 12° F. below normal (corresponding to a thickness anomaly of −210 ft.) over Great Britain (fig. 5). Note also the strong northeasterly anomalous flow at 700 mb. (fig. 1). This month's cool, rainy regime throughout most of Europe was in sharp contrast to the summer of 1955 when anticyclonic conditions produced warm, dry weather [5, 7].

In the Pacific at least five typhoons were observed in August, with a tendency for these storms to move farther westward before recurving, than is usual for this time of year. Presumably this was related in part to the +90-ft. height anomaly center south of Japan (fig. 1). One of the worst of these storms, typhoon Wanda, smashed into the China coast south of Shanghai early in the month. Two thousand persons were reported killed and millions were made homeless before the storm blew itself out deep in the interior of China.

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Weather Notes

BETSY'S ROVING EYE

Between 1700–1900 GMT on August 11, 1956, Hurricane Betsy's eye passed north of the island of Dominica in the northernmost Windward Islands of the Lesser Antilles. After entering the Caribbean Sea the hurricane's eye had a diameter of 10 nautical miles on the Navy reconnaissance aircraft radar as observed by Lt. A. N. Fowler. The eye was continuing what appeared to be a sinusoidal path west-northwestward toward Puerto Rico. (See fig. 1.) The amplitude of its curve averaged about 15 nautical miles and during its initial movement into the Caribbean Sea showed a wave length of 130 nautical miles. From the beginning of its Caribbean trajectory across the Windward Islands until it reached 64° W., the curve crossed its axis on the average of every 5 hours with a period of 10 hours.

At 0400 GMT on August 12, as the eye approached its last well-defined swing to the right, it was 16 nautical miles in diameter with moderate echoes in several spiral bands extending 70 nautical miles north and 40 west. However after it reached 65° W., the track of the eye lost its sinusoidal character. This might be explained by the slight change in direction from west-northwest to northwest. In addition, the storm's proximity to the Virgin Islands and Puerto Rico may have somewhat distorted its rhythmic movement.

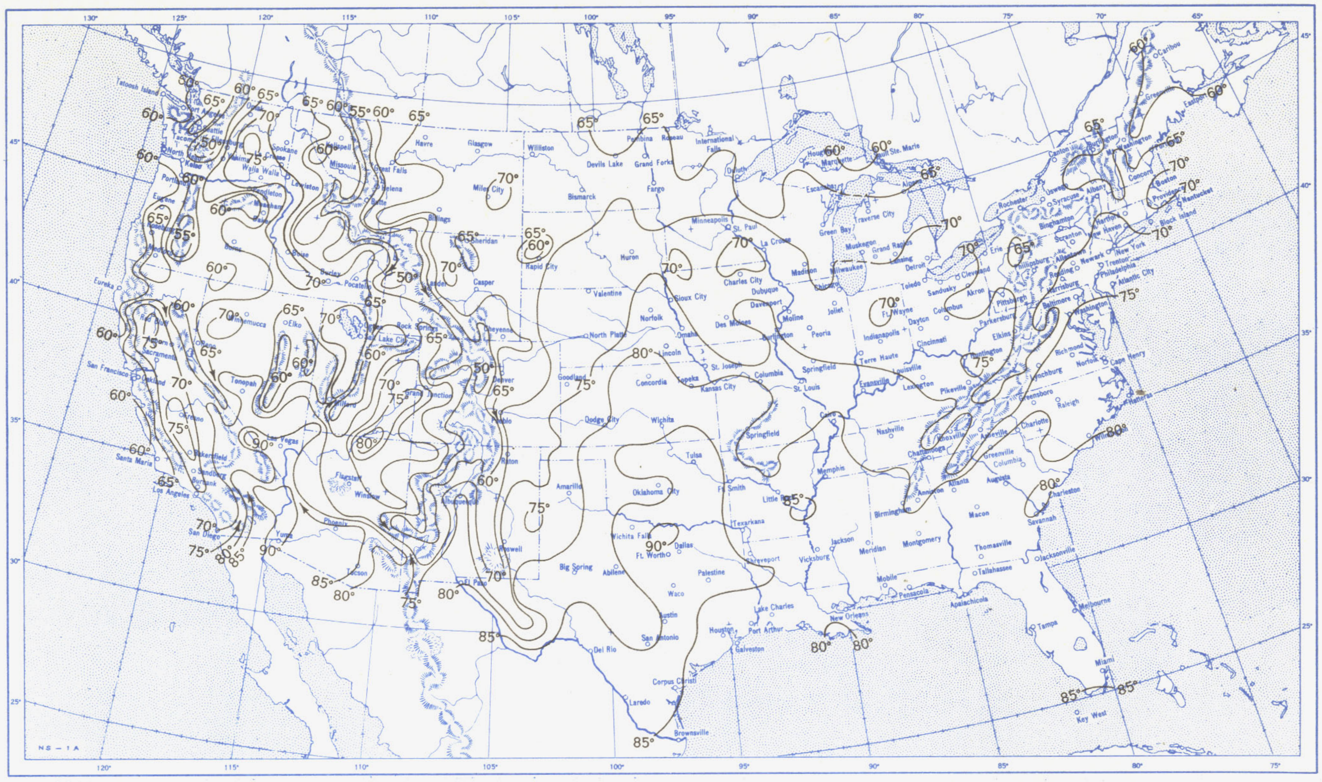
Precipitation bands around the circulation eye continued to vary the diameter and at 0830 GMT the center was 18 nautical miles across located about 75 nautical miles to the southeast of Puerto Rico. Somewhere in this location the storm inflicted its first loss of life inside the Caribbean. The *Elena*, a 91-ton vessel en route through the Virgin Islands, broke up so fast that the crew was unable to radio for help and two seamen were drowned. Another larger ship, the 4,381-ton tanker *Michael J.*, was more fortunate. On Saturday morning it heeded the hurricane warnings and when it was south of St. Croix, it began fleeing southward. Several days later it was located 200 miles south of Puerto Rico adrift with engine trouble and without radio contact.

By 0845 GMT the hurricane was located on the San Juan radar but because of local obstructions and terrain to the southeast of the station the eye could not be fixed.* Between 1200 and 1230 GMT a closed circulation was observed with a diameter of 8 to 10 nautical miles. This was one of the smallest diameters so far reported along the track and indicated that precipitation had closed the eye with concentric bands as it neared the land. As it approached the southeastern coastline its movement between 1200 and 1230 GMT oscillated back and forth and was so erratic that it seemed to be deflected by the terrain. (Perhaps an analysis of the radar film will show somewhat less oscillation than is shown in the radar track plotted on figure 1.) The terrain in the southeastern coastal area slopes abruptly from the coastline to about 1,500 feet with a peak of 2,890 feet in the Sierra de Cayey chain. The eye entered the coastline near Maunabo and moved near Yabucoa, then curved erratically westward toward Guayama. Calm winds were reported at Maunabo as well as at Patillas indicating the eye's passage through these towns.

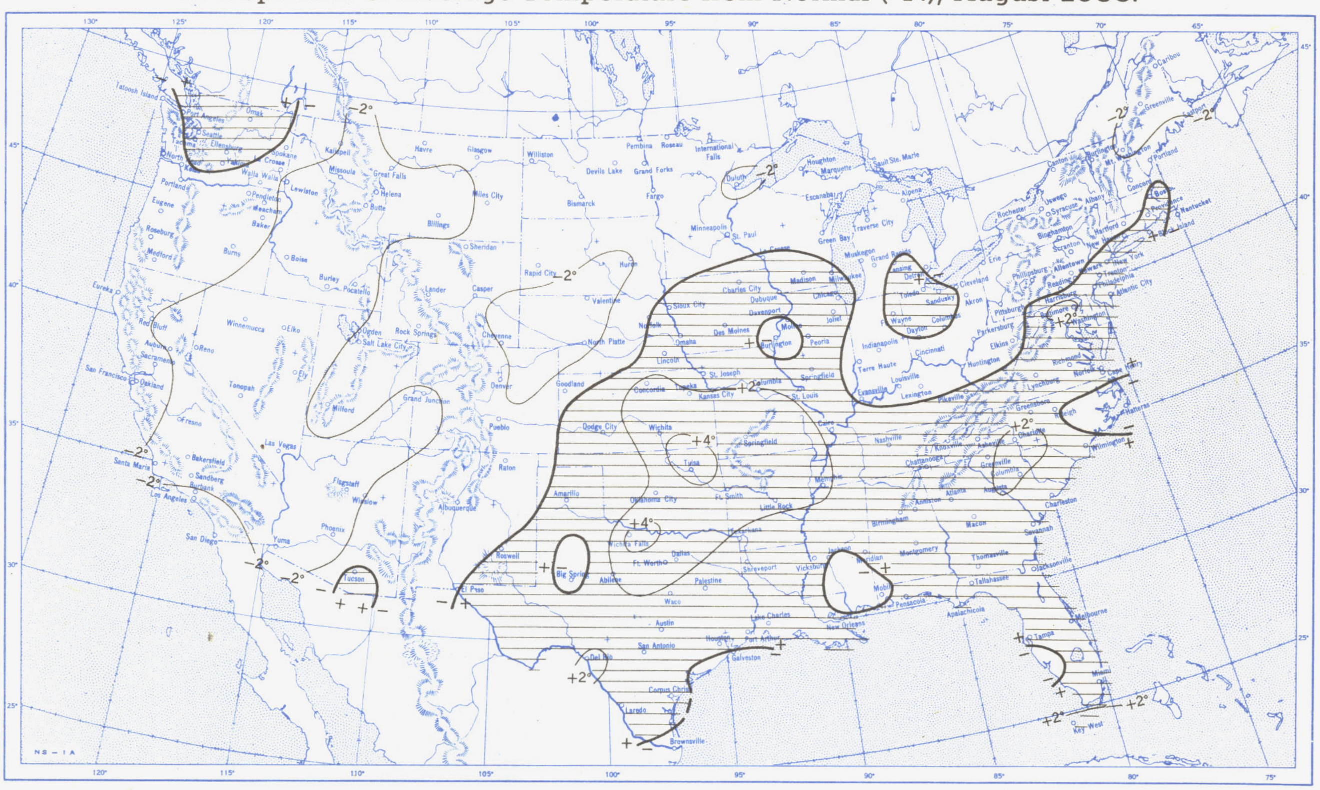
It is difficult to believe that hurricane Betsy could be deflected by terrain of such dimensions. If the radar positions of the eye were eliminated between 1200 and 1230 GMT, the extrapolated track from the southeastern coast of Puerto Rico to the northwestern coast would assume a more symmetrical line and would even tend toward a quasi-sine curve. Unfortunately there were no pressure readings while the hurricane was in this area. The eye was distorted and seemed to be breaking up over land at 1300 GMT. At 1315 GMT the eye was in the vicinity of Cayey and calm winds were reported there. At that time the eye's diameter was around 6 nautical miles with a sharp tilt toward the northwest. Cayey is located in a valley in the Central Cordillera bounded by peaks of 2,500 to 3,000 feet on the east and 2,200 to 2,800 feet on the west. At one time the eye was observed to take a "square" shape on the scope. Mr. Rockney momentarily fixed the radar antenna at 5,000 feet and the eye was observed to take a more circular shape.

*The radar observer during this period was Mr. Vaughn Rockney.

Chart I. A. Average Temperature (°F.) at Surface, August 1956.

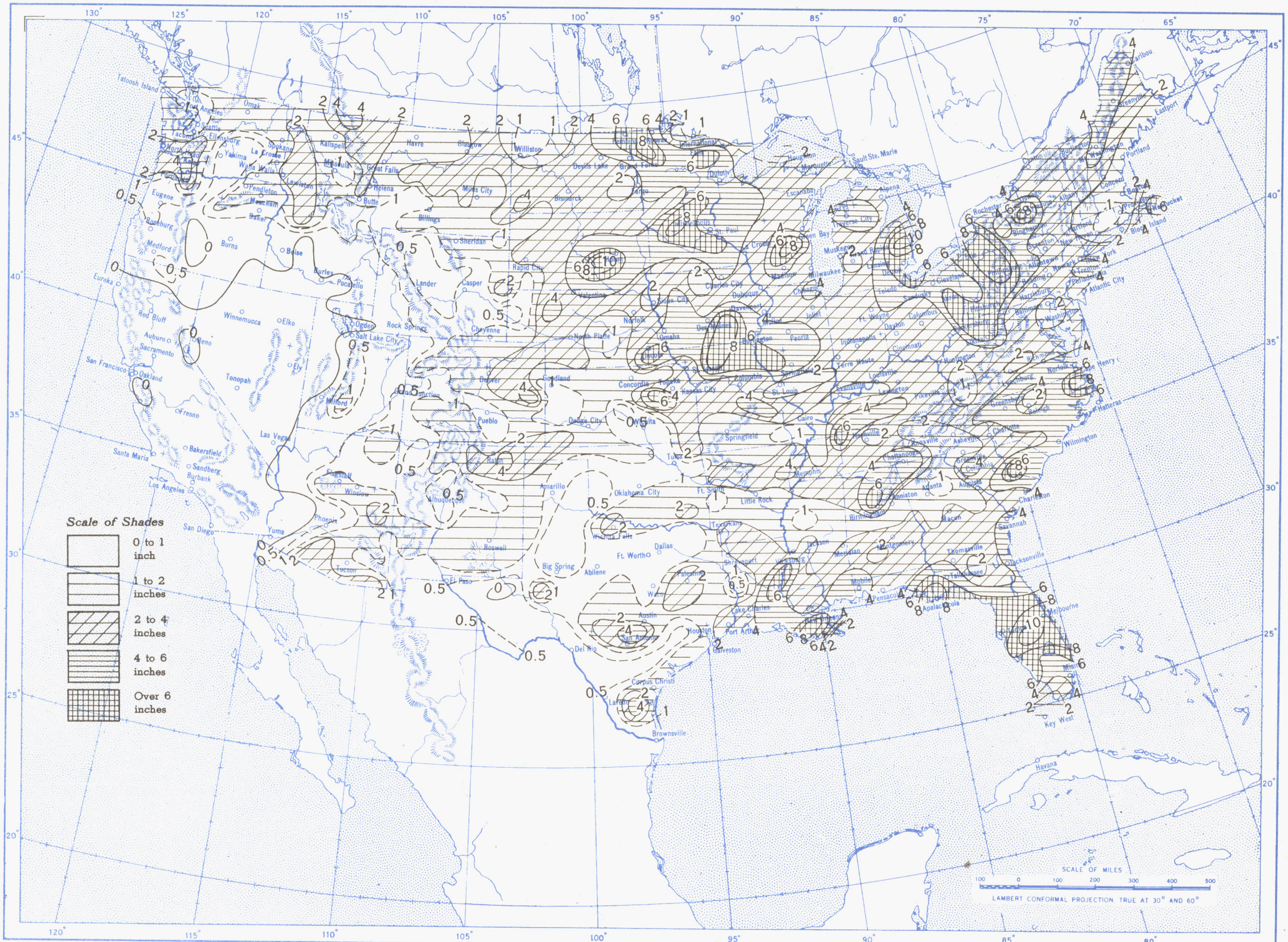


B. Departure of Average Temperature from Normal (°F.), August 1956.



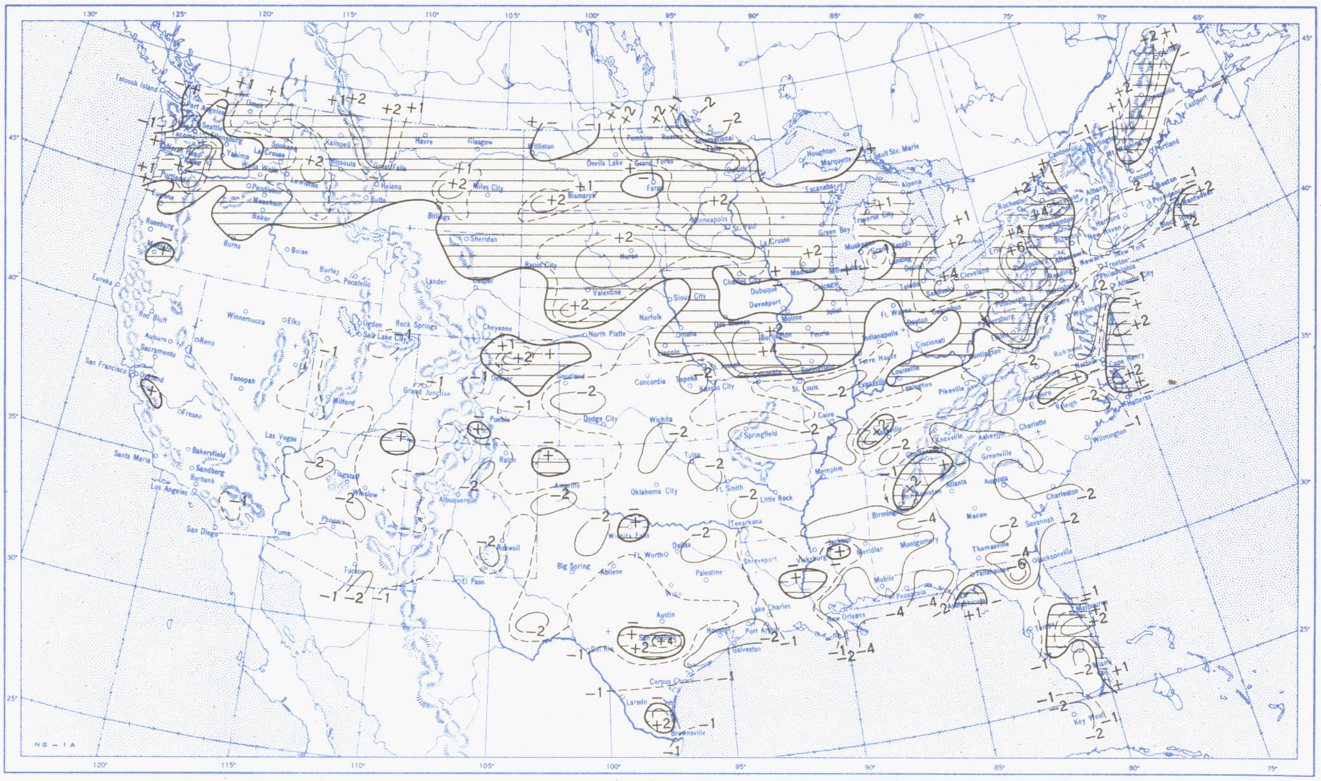
A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), August 1956.

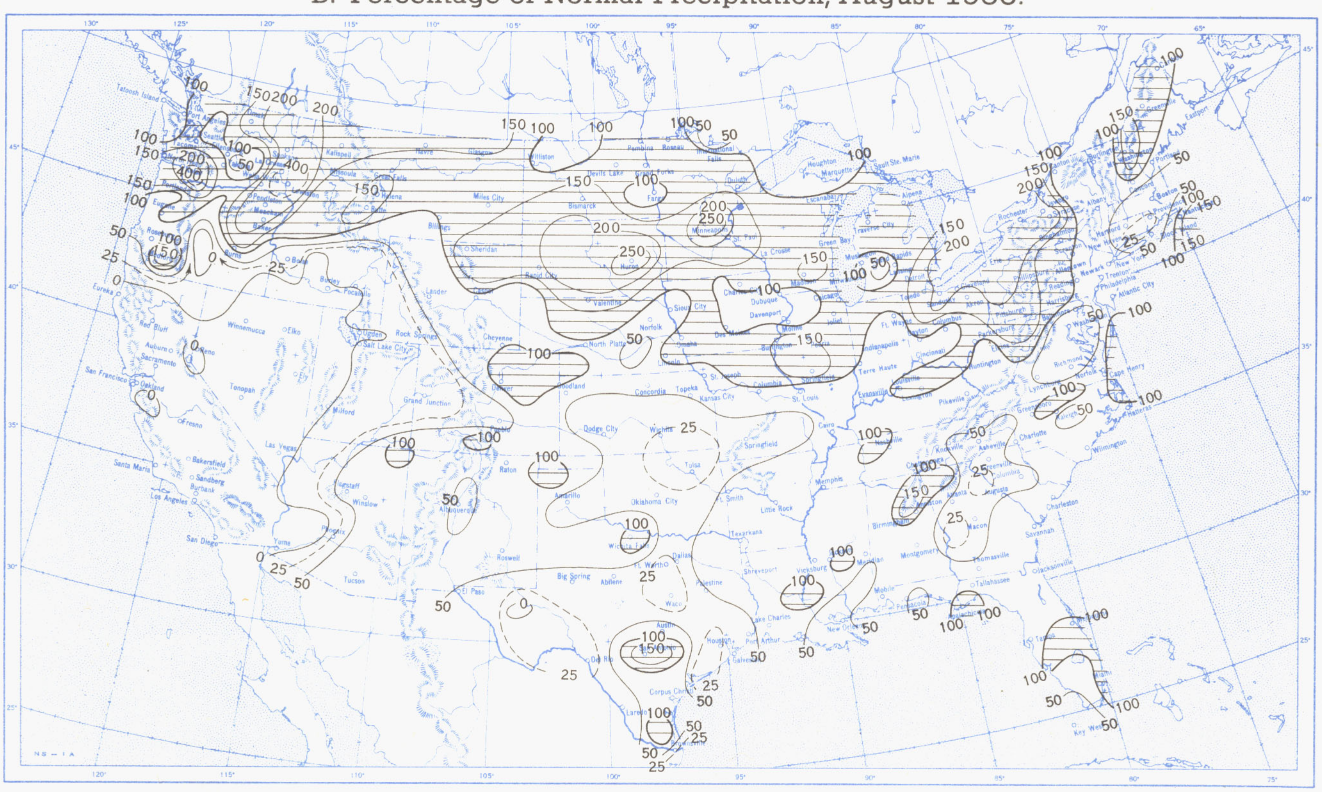


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), August 1956.

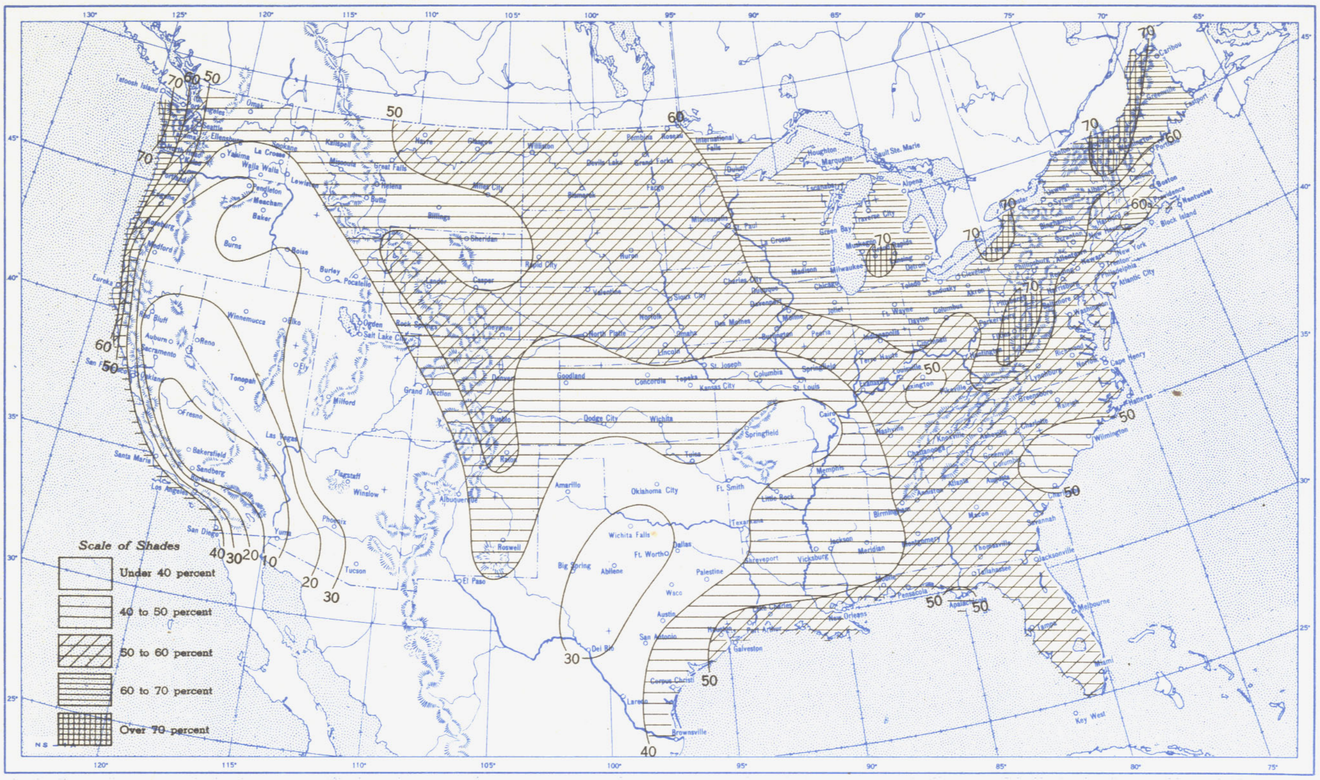


B. Percentage of Normal Precipitation, August 1956.

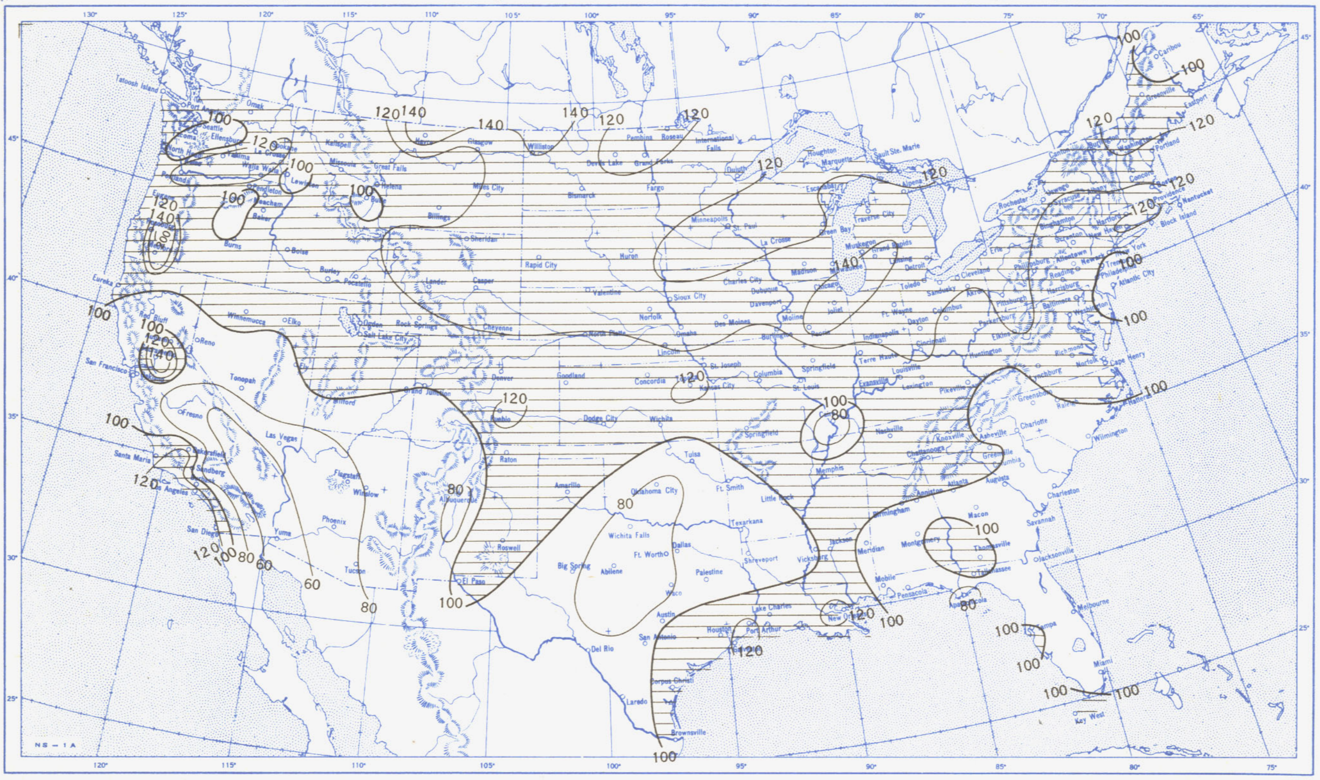


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, August 1956.

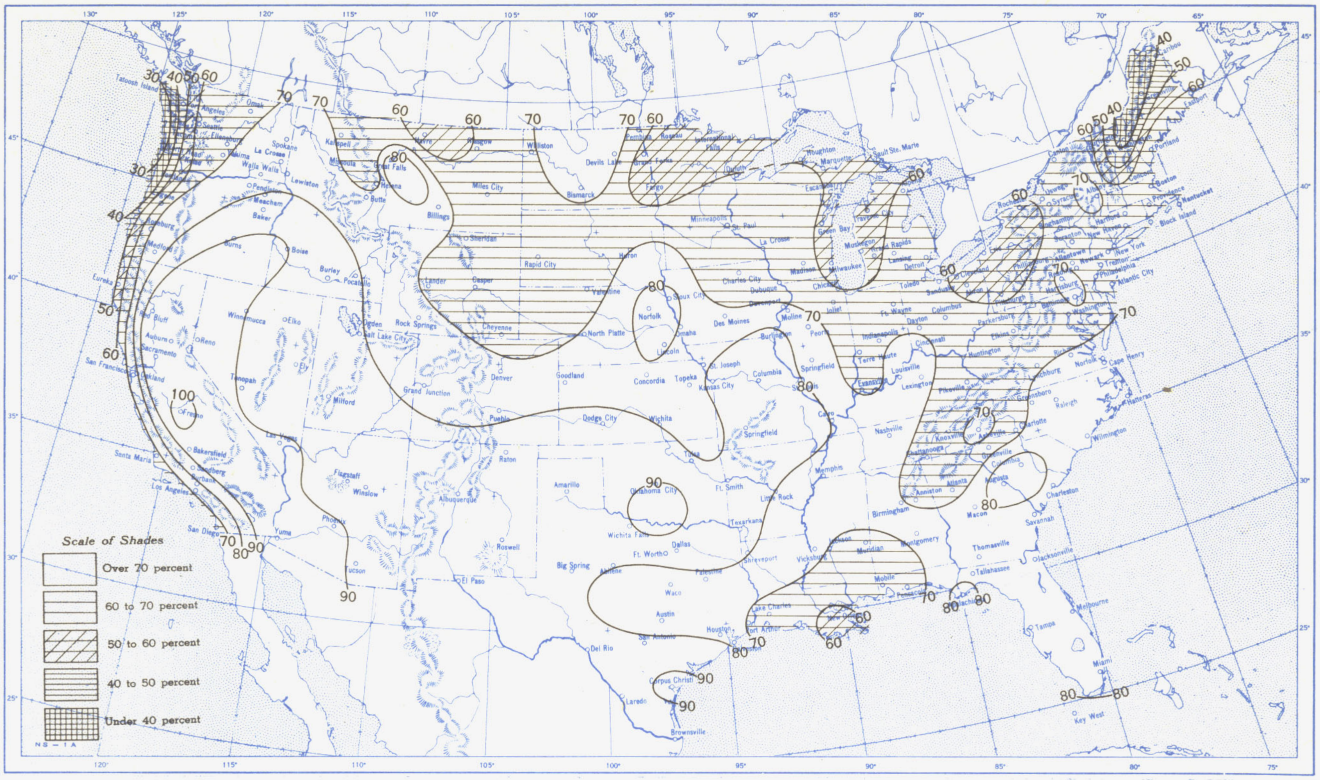


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, August 1956.

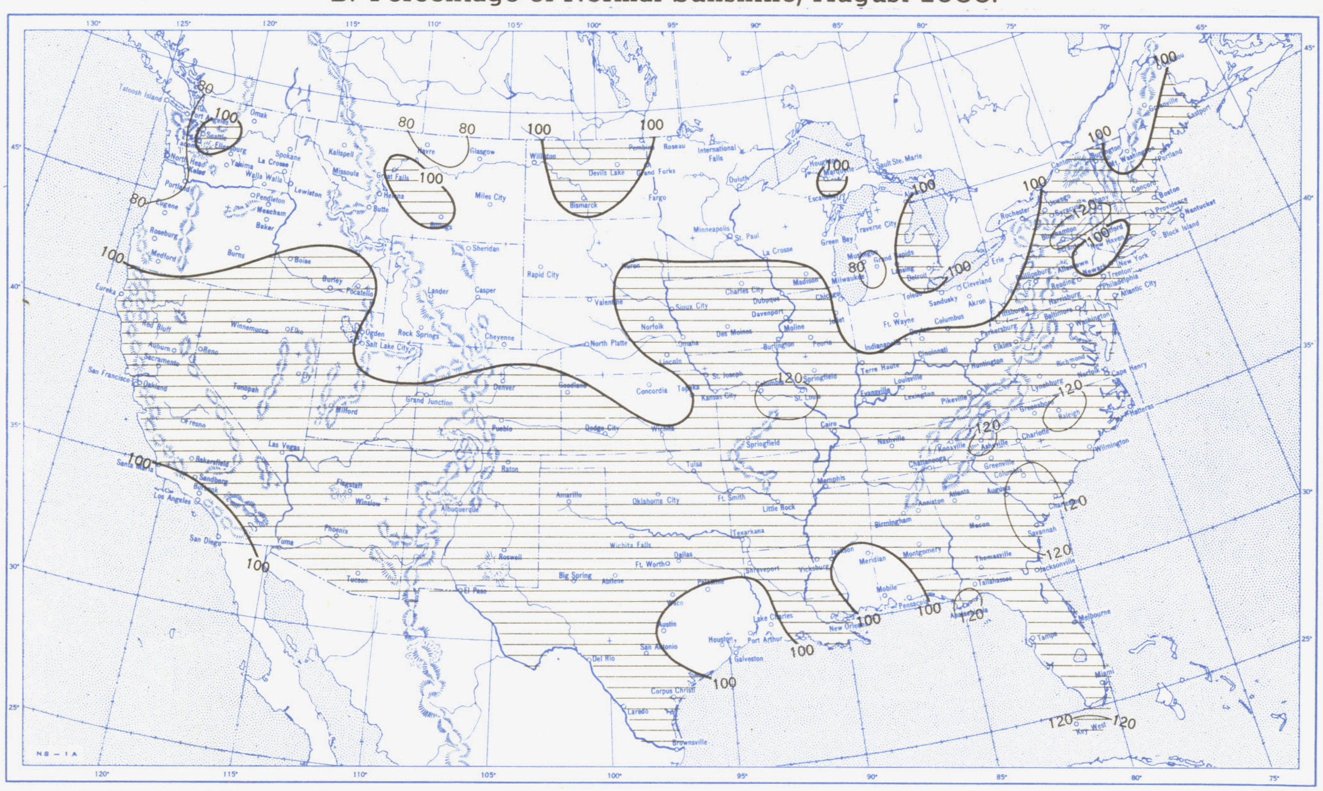


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, August 1956.



B. Percentage of Normal Sunshine, August 1956.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, August 1956. Inset: Percentage of Mean Daily Solar Radiation, August 1956. (Mean based on period 1951-55.)

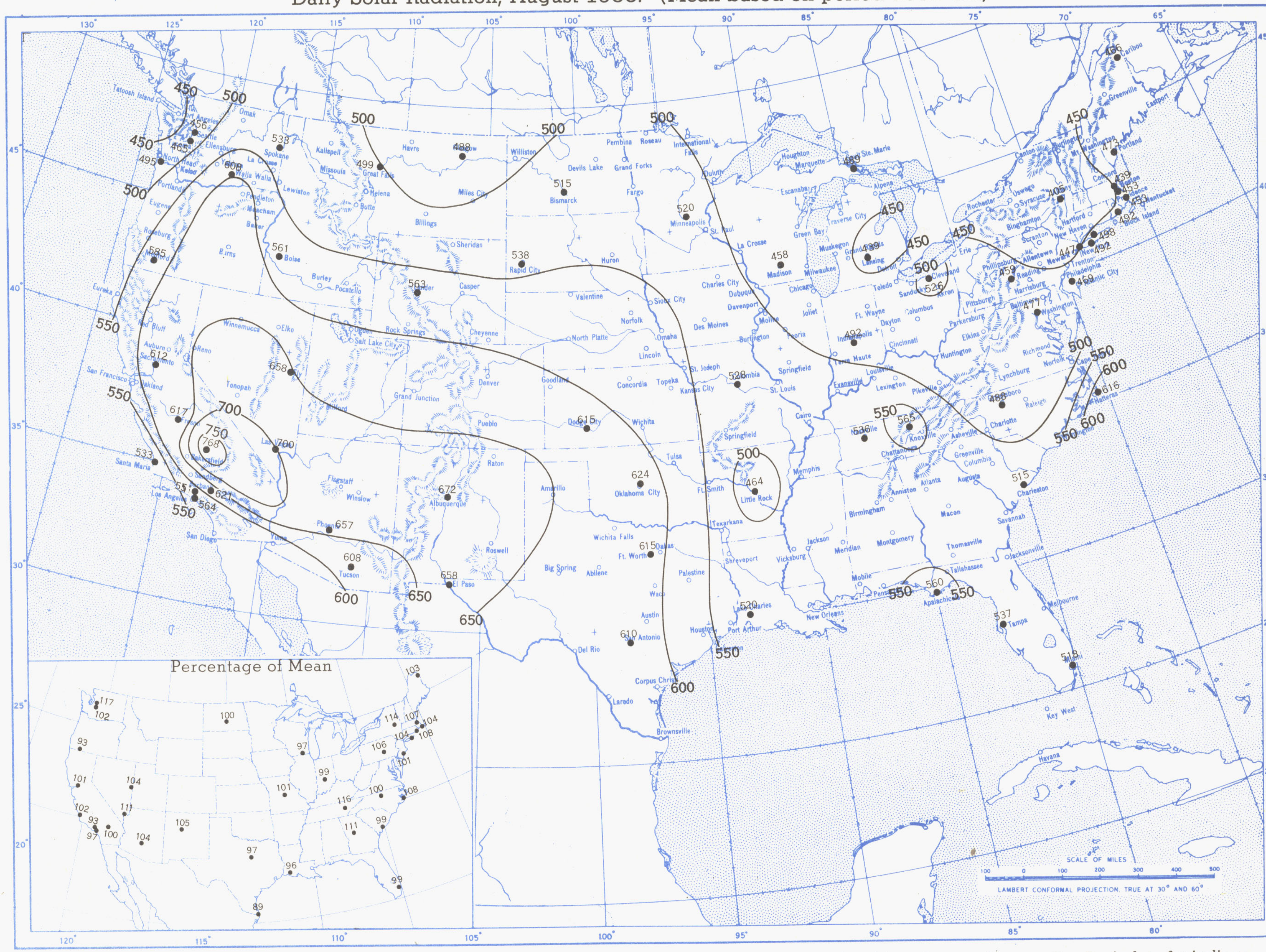
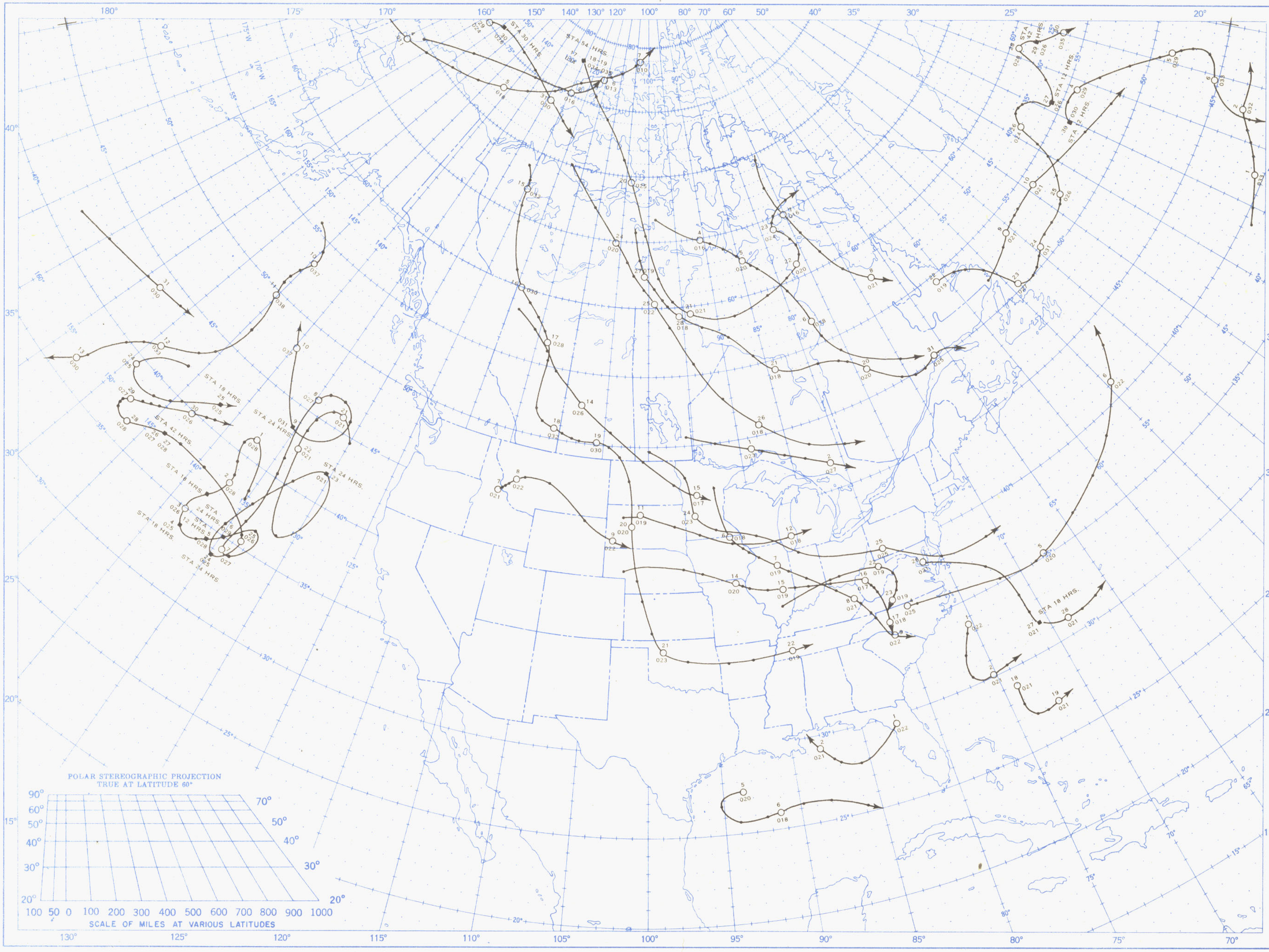


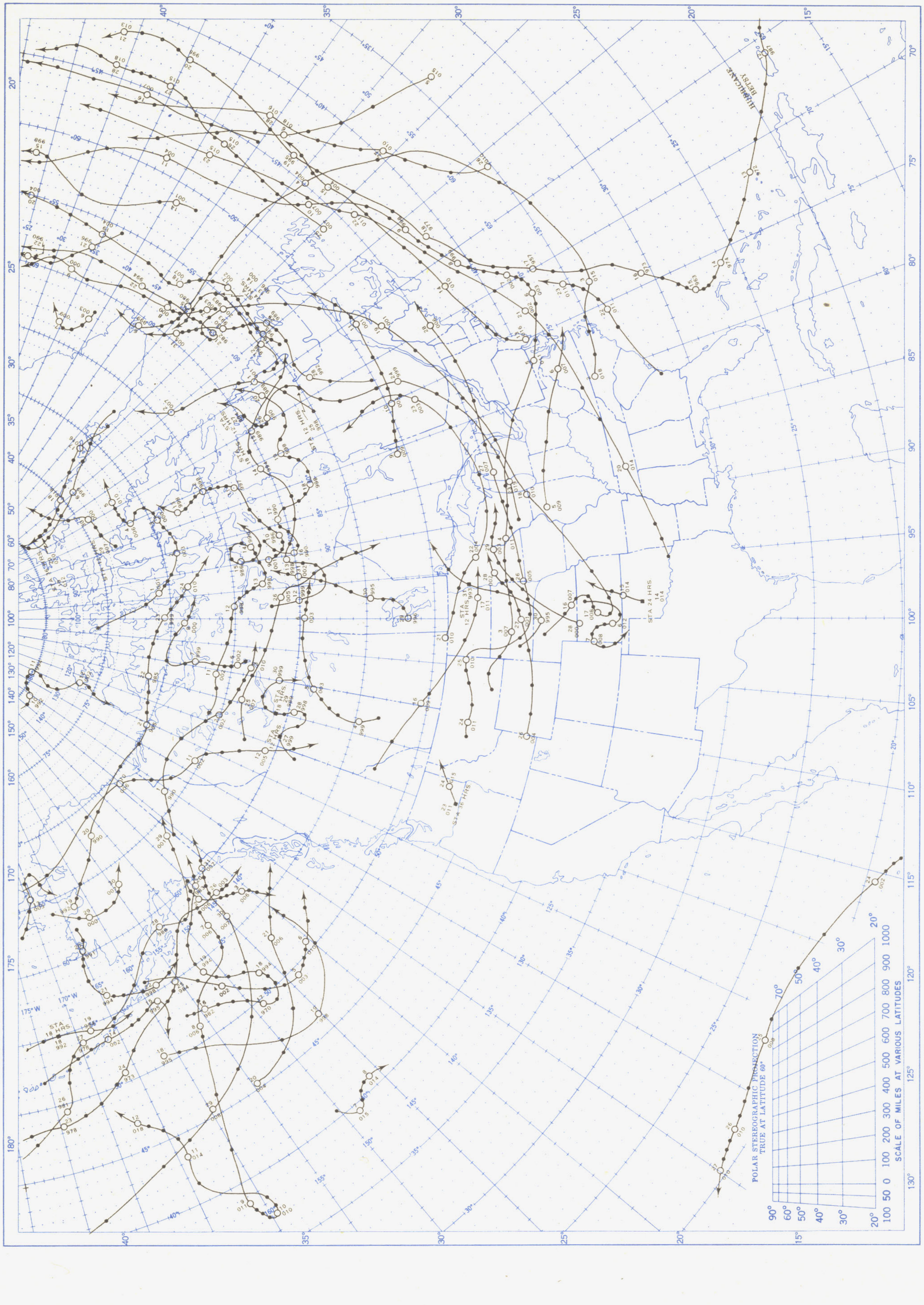
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, August 1956.



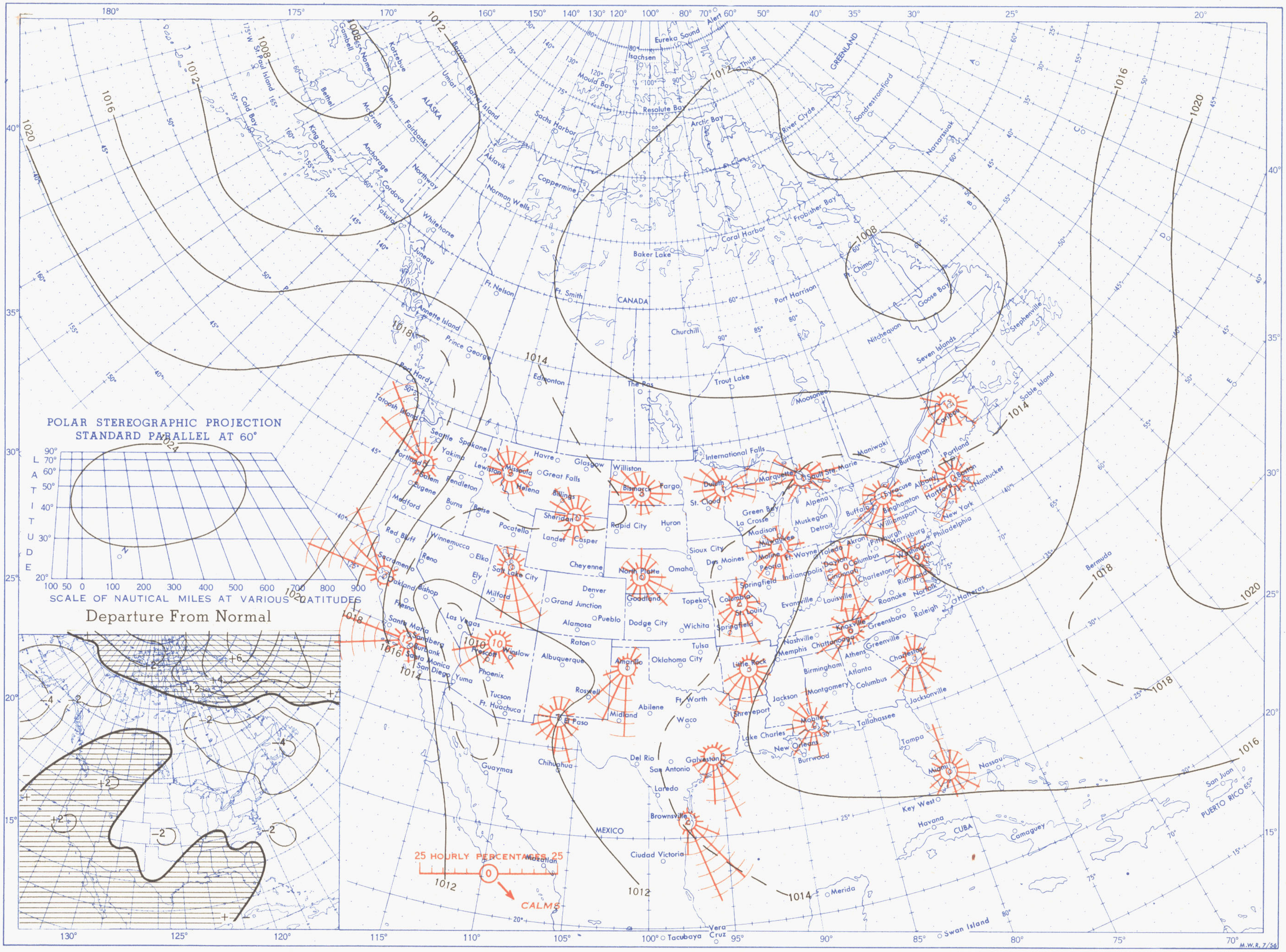
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, August 1956.



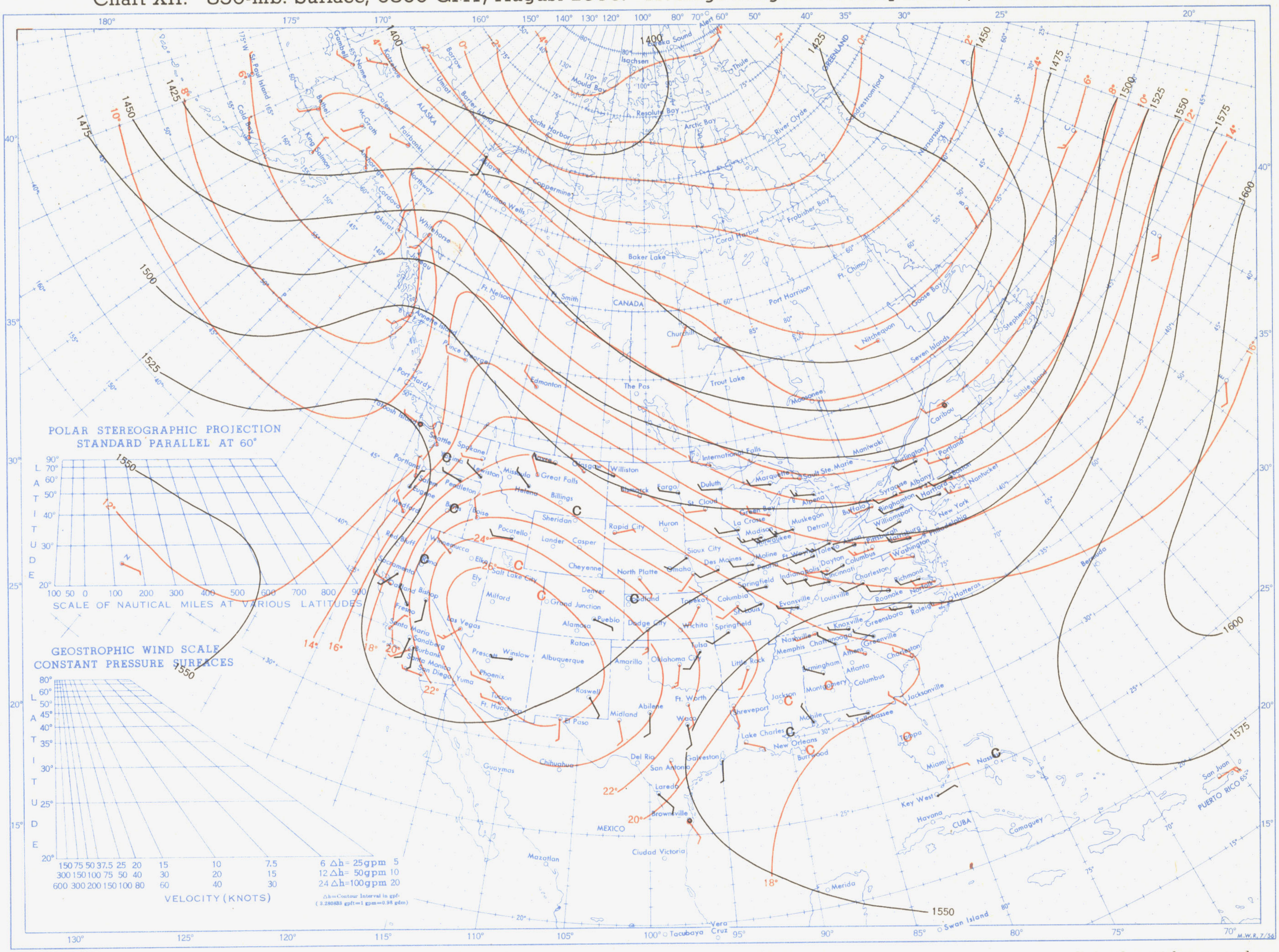
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, August 1956. Inset: Departure of Average Pressure (mb.) from Normal, August 1956.



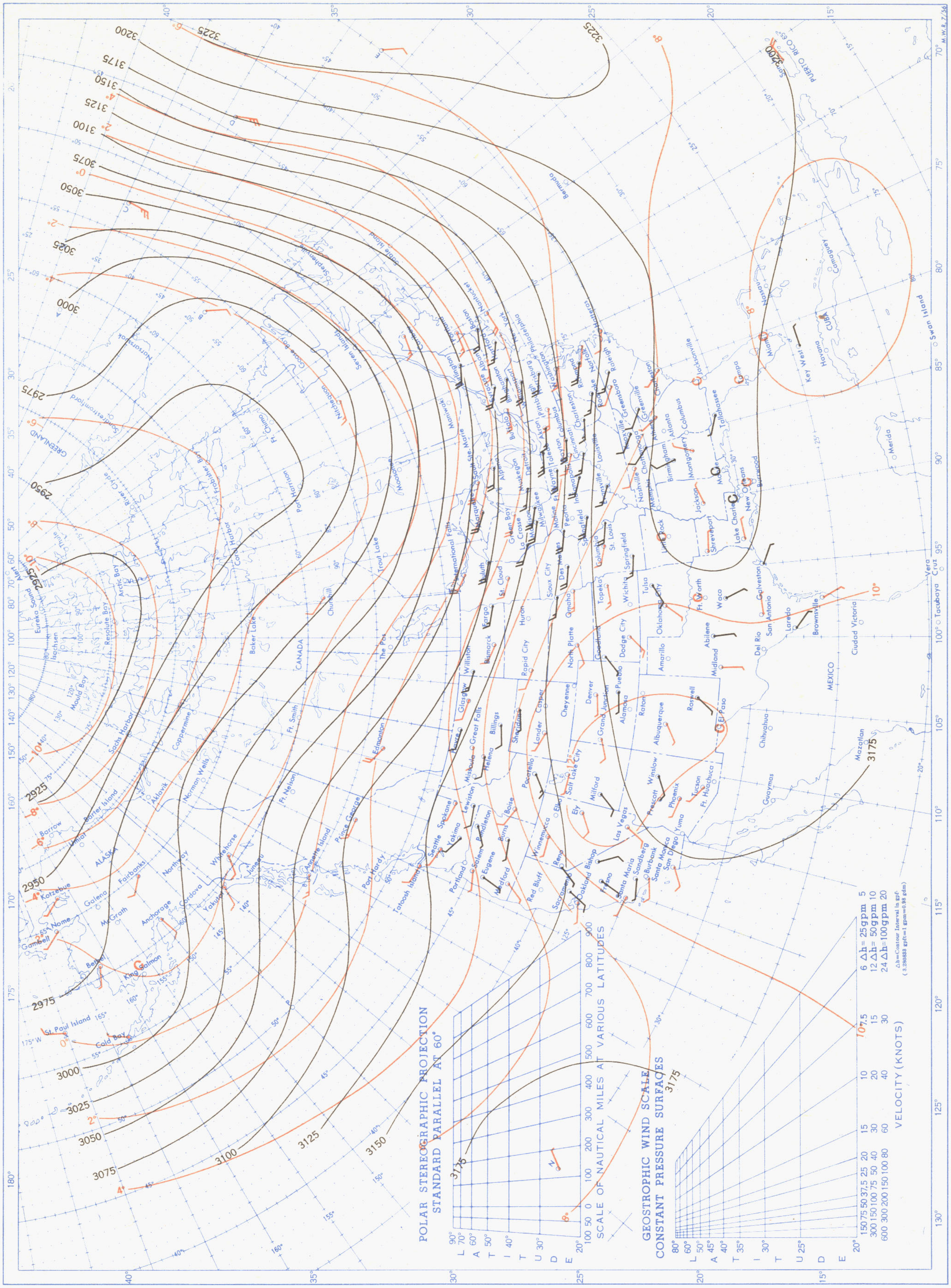
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. 850-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



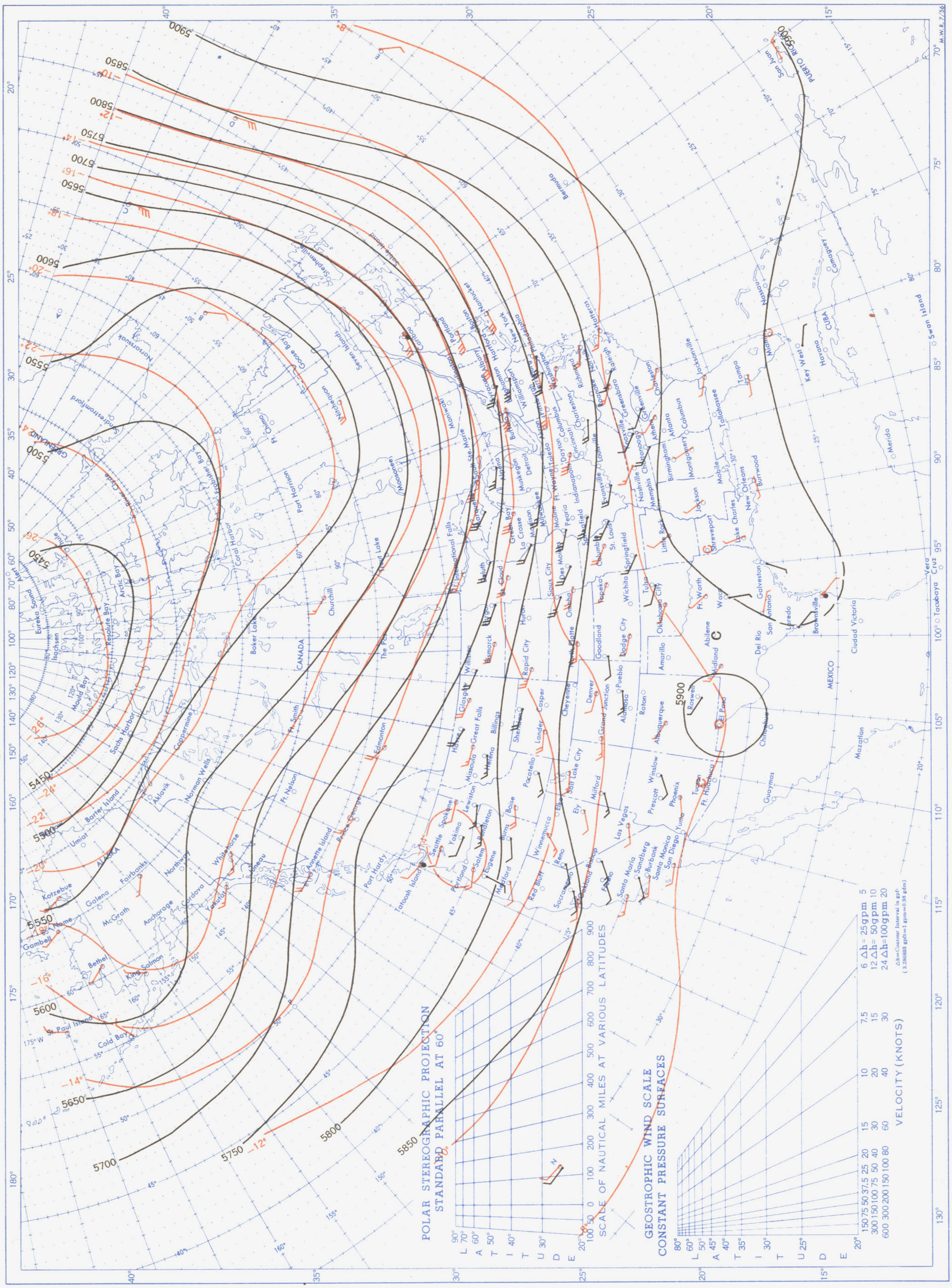
Height in geopotential meters (1 g.p.m. = 0.98 dynamic meters). Temperature in °C. Wind speed in knots; flag represents 50 knots, full feather 10 knots, and half feather 5 knots. Winds shown in red are based on rawins taken at the indicated pressure surface and time. Those in black are based on pibals taken at 2100 GMT and are for the nearest standard height level.

Chart XIII. 700-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



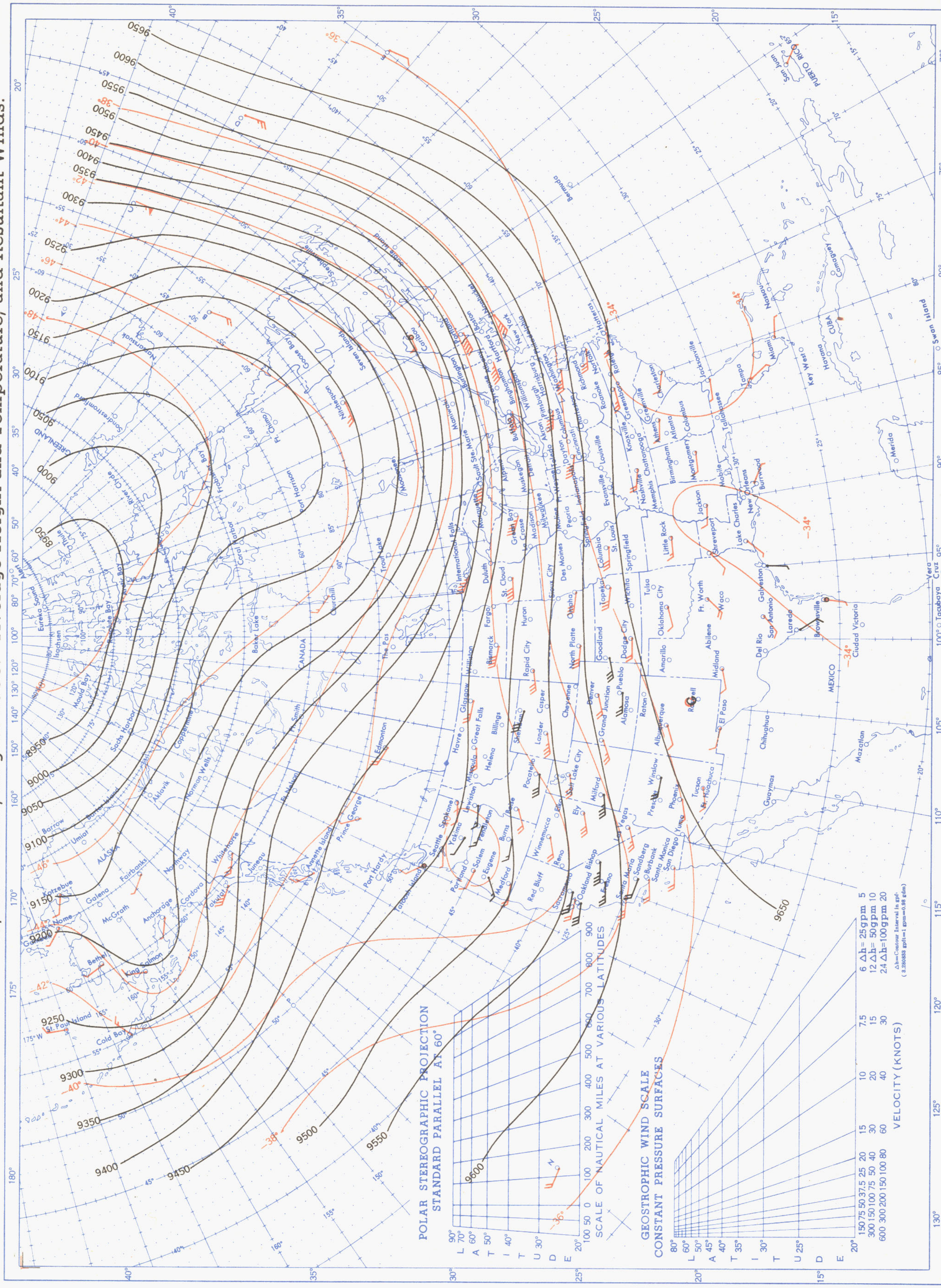
See Chart XII for explanation of map.

Chart XIV. 500-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



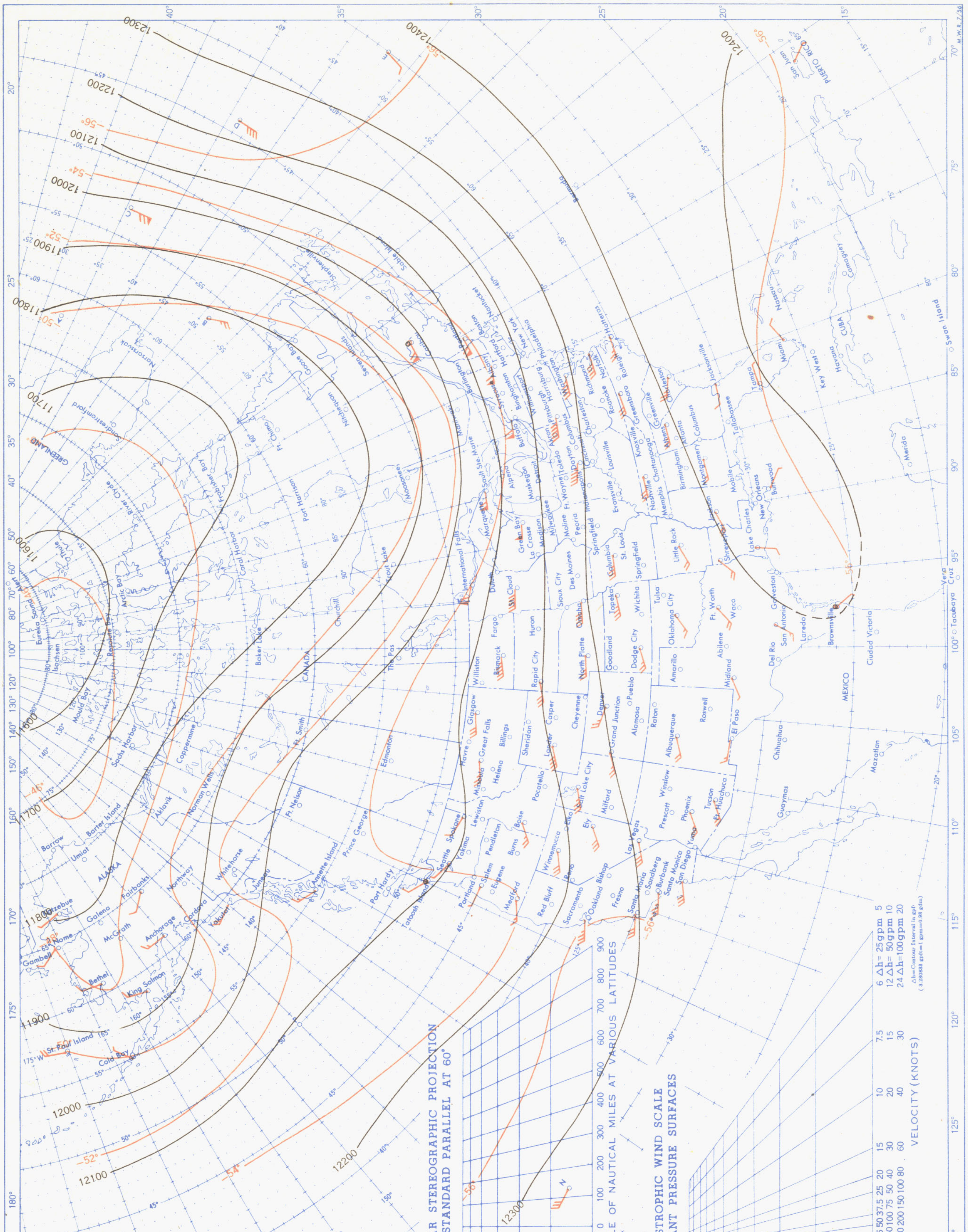
See Chart XII for explanation of map.

Chart XV. 300-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



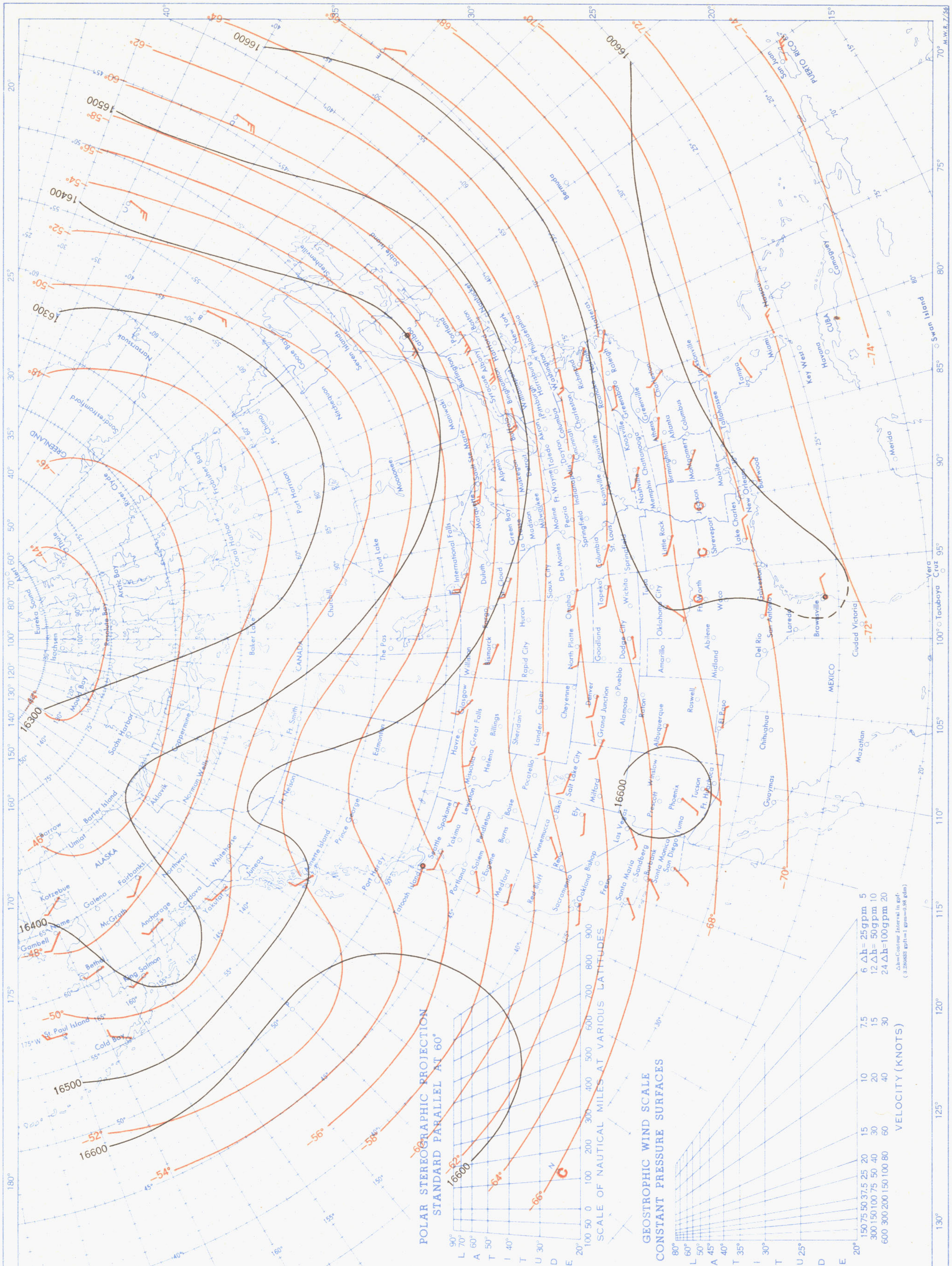
See Chart XII for explanation of map.

Chart XVI. 200-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map. All winds are from rawin reports.

Chart XVII. 100-mb. Surface, 0300 GMT, August 1956. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map. All winds are from rawin reports.